U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE
SUBCOMMITTEE ON ENERGY

HEARING CHARTER

Keeping the Lights on: Removing Barriers to Technology to Prevent Blackouts

Thursday, September 25, 2003
10:00 a.m. – 12:00 Noon
2318 Rayburn House Office Building

1. Purpose

On Thursday, September 25, 2003 at 10:00 a.m., the Energy Subcommittee of the House Committee on Science will hold a hearing to examine the role of technology in preventing future blackouts and the current economic, regulatory and technical barriers to improved reliability. The hearing will also examine the role of the Department of Energy's (DOE) newly established Office of Electric Transmission and Distribution in enhancing the power grid's performance and reliability.

2. Witnesses

The following witnesses will testify at the hearing:

Mr. James W. Glotfelty is the Director of the U.S. Department of Energy's Office of Electric Transmission and Distribution. Previously, Mr. Glotfelty served as a senior advisor to the Secretary of Energy, where he was a co-leader in the Department's contribution to the National Energy Plan. Mr. Glotfelty also served as an advisor on electricity to then-Governor Bush.

Mr. T.J. Glauthier is the President and Chief Executive Officer of the Electricity Innovation Institute, a new non-profit affiliate of the utility industry's research consortium (Electric Power Research Institute or EPRI). Prior to joining the Institute, Mr. Glauthier was the Deputy Secretary and Chief Operating Officer of the Department of Energy and he served for five years at the Office of Management and Budget as the Associate Director for Natural Resources, Energy and Science.

Mr. Thomas R. Casten is the founding Chairman and CEO of Private Power LLC, an independent power company in Oak Brook, IL which focuses on developing power plants that utilize waste heat and waste fuel. Mr. Casten also serves on the board of the American Council for an Energy-Efficient Economy (ACEEE), the board of the Center for Inquiry, and the Fuel Cell Energy Board. He is also the Chairman of the World

Alliance for Decentralized Energy (WADE), an alliance of national and regional combined heat and power associations, wind, photovoltaic and biomass organizations and various foundations and government agencies seeking to mitigate climate change by increasing the fossil efficiency of heat and power generation. Prior to Private Power LLC, Mr. Casten served as President of the International District Energy Association and he received the Norman R. Taylor Award for distinguished achievement and contributions to the industry.

Dr. Vernon L. Smith is a Professor of Economics and Law and the Director of the Interdisciplinary Center for Economic Science at George Mason University. Dr. Smith, who won the Nobel Prize in economics in 2002, is widely recognized as the 'father of experimental economics' and his current research focuses on the design and testing of markets for electric power, water, spectrum licenses and public goods as well as continuing behavioral and evolutionary research on trust and reciprocity.

3. Overarching Questions

The hearing will focus on several overarching questions:

- Which technologies have the greatest potential to increase the reliability and the efficiency of the U.S. electrical system both now and in the future? How do the costs and benefits of these different technologies compare?

- What technologies are the DOE's Office of Electric Transmission and Distribution developing? Do technologies to increase reliability exist and are they ready to be deployed today?

- What is the state of R&D funding for our electrical systems? Where should federal R&D funding be focused to ensure maximum benefit and future flexibility?

- What are the current and future barriers to the commercial application of emerging technologies? What steps have been taken to address these obstacles?

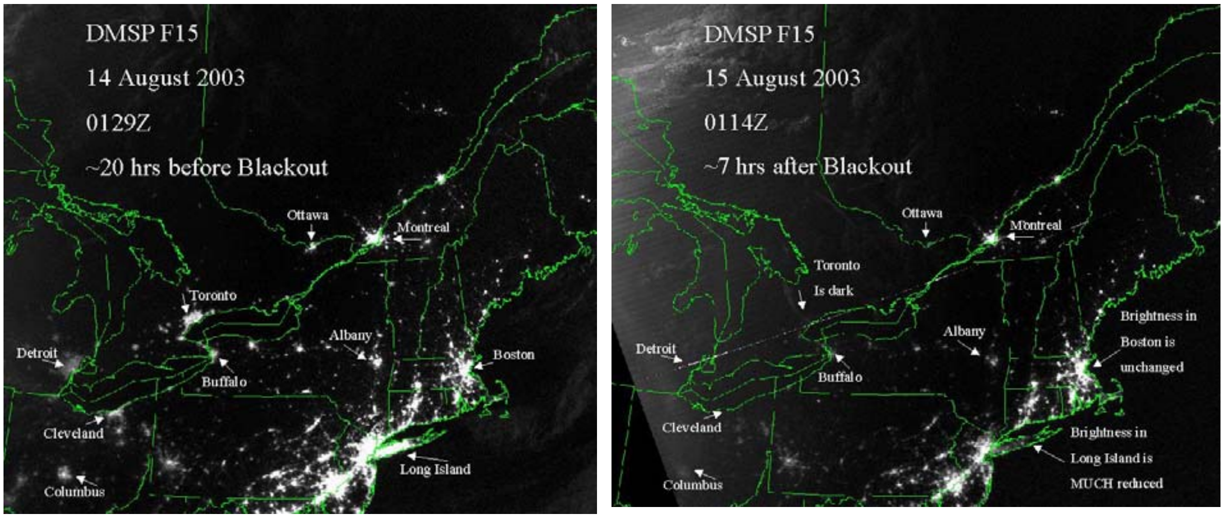

Figure 1. View from Space before and during August Blackout.

4. Brief Overview

- On August 14, 2003, a major power outage occurred across the northeastern and upper mid-western part of the United States and portions of Canada, affecting nearly 50 million customers.
- A joint U.S.-Canada task force has been established to determine the causes of the blackout.
- A contributing factor of the recent blackout – and others – was the deregulation of the utility industry, where companies no longer own their own transmission lines. As a result, investment in the infrastructure has remained flat, despite increases in electricity.
- Several solutions, including demand response, advanced transmission monitoring, communications and controls, advanced conductors, and distributed generation, have been proposed, but barriers remain. New technologies are not widely used, great variability in rules, regulations and technical specifications exist at the local level, and the cost to upgrade systems is high.
- Earlier this year (prior to the August blackout), the Administration established a new Office of Electric Transmission and Distribution at the Department of Energy in order to better address electric reliability concerns.

5. Background

On Thursday, August 14, a little after four o'clock in the afternoon, the power went out for 50 million Americans. While the precise sequence of events is not yet known, overloading of a portion of the Nation's transmission system clearly played an important role that was possibly compounded by human error and unclear lines of responsibility. Although this was the largest blackout ever in the U.S., several other serious blackouts have occurred in recent years, most notably in the Northwest in 1996, but also in San Francisco, Texas, New York State and Memphis, Tennessee.

To investigate the causes of the blackout, Energy Secretary Spencer Abraham is co-chairing a U.S.-Canadian task force, and Mr. James Glotfelty, Director of DOE's Office of Electric Transmission and Distribution, is coordinating DOE's participation in the task force's activities. One contributing factor in the most recent blackout and several of the others was the changing structure of the utility industry. As a result of deregulation, companies that generate electricity often no longer own the transmission lines they use for distribution. In addition, the companies that distribute the electricity buy power from a variety of generators, meaning that transmission lines move power in more directions than was originally contemplated. Worse, uncertainty over the future of deregulation has held investment in transmission lines relatively flat as potential investors have been unsure of how they would reap a profit. As a result, few additional transmission lines have been built and few have been upgraded relative to the increase in demand.

Technology Solutions

Building new transmission lines would ease pressure on the system, but other options may be less expensive and create less controversy. Several of the options are discussed below.

1) Demand Response

The demand for electricity varies widely over the course of a day, a month, and even a season. Highest usage, or so-called "peak load", typically occurs in the afternoons on hot summer days when air conditioners are on full power. This peak load fills the transmission grid and strains the electrical system. It is therefore no surprise that blackouts often occur during these peak times of demand.

At times of peak demand, utilities bring on-line older and more inefficient electric generators for the sole purpose of generating peak power. This, combined with the fact that lines are hot from overloading electricity, results in higher costs and less efficiency Despite these increased costs – as much as ten times more – the price to the average consumer does not change throughout the day, so the customer has no incentive to change their demand.

Fortunately, new technologies coupled with pricing systems that charge more during peak periods can lead to significant reductions in demand. With so-called "demand response technologies," a utility can send a signal to a home or business when prices are peaking, and electrical equipment in the house can be programmed to shut off specific appliances at a particular price level. For example, one program in Florida is saving consumers an average of 15 percent off their energy bills by providing time-variant pricing and demand response technologies, for a fee. In turn, this has reduced the average household demand during peak periods by about 50 percent.

2) Advanced Transmission Monitoring, Communications and Controls
Advanced transmission control systems – sometimes called "smart grid" technologies – can increase the ability of utilities to control power flows on transmission lines. This emerging technology could prevent blackouts by enabling utilities to better monitor power flows and to limit current in dangerous situations without shutting it off completely. It could also more quickly and automatically direct the flow of current away from overloaded lines. (There is mounting evidence that during the August blackout controllers had little or no idea of the extent of the grid problems.) New technologies can also help utilities better model the grid so they can make informed decisions about how to handle problems.

3) Advanced Conductors
New technologies, including advanced wires made from ceramic composites and superconductors, could enable utilities to carry more electricity on fewer wires. Although more expensive, composites now being tested can carry two to three times the power on the same diameter as regular wires. Superconducting wires, which are also just starting to be tested, must be cooled below -300^{o} F, but they can carry far more current with only negligible losses in power. Superconducting wires are likely to be first used in generators and transformers where they can dramatically increase efficiency, and then in short, constrained segments in urban settings, where they can be placed in existing conduits to significantly increase the flow of electricity. Other technology includes devices for electricity storage. Although currently expensive, storage could help reduce peak loads by storing off-peak power for use when demand is high.

4) Distributed Generation
Distributed generation – the use of multiple, small generators close to the users of the electricity – can ease demand by providing electricity that does not have to move over the transmission system. Distributed generation technologies include fuel cells, microturbines, reciprocating and Stirling engines, photovoltaics (solar energy), wind turbines, and a variety of other technologies. Distributed generation also offers security benefits, especially reduced vulnerability to catastrophic damage, whether from natural or man-made disasters.

Barriers

Despite a large Federal investment – DOE has funded more than $1.2 billion in research and development since 1980 for electricity transmission and distribution research, and at least as much for various distributed generation technologies – these technologies are not in widespread use. Significant regulatory barriers, particularly in the areas of interconnection standards and market structure, impede the adoption of new technology. Interconnection standards – rules, regulations, and technical specifications that determine how electrical devices connect with local distribution grids – vary widely among different localities. The lack of uniform national standards and the existence of sometimes arcane local rules and regulations often make it prohibitively expensive to connect a distributed generation power unit to a distribution grid. A national consensus interconnection standard would reduce the cost of hardware, and significantly reduce the need for installation inspections and on-site certifications. Market structures currently in place also vary significantly by region, but very few of them are designed to convey accurate price signals to consumers indicating the true costs of electricity usage at times of peak demand.

As is often the case, the cost of installing upgraded technology can be a barrier. Some have estimated that transmission grid modernization could cost $50 billion or more over the next ten years. This translates to about one- or two-tenths of a cent per kilowatt-hour (a dollar or two per month for the average customer). But the costs of an unreliable electric system are even higher, with costs from the August blackout alone estimated to be between $4 and $6 billion. As many local victims of hurricane Isabel's wrath will attest, extended blackouts can result in spoiled food, lost work and other economic costs.

Office of Electric Transmission and Distribution

Secretary Abraham created the DOE Office of Electric Transmission and Distribution (OETD) earlier this year to address two primary functions: research and development (R&D) on electricity transmission and distribution technologies, and systems operation research and policy analysis related to the electric system. The programs run by the Office are not new; they come from various parts of DOE, primarily from the Office of Energy Efficiency and Renewable Energy (EERE).

The Department created the new office in response to recommendations from a series of reports. *The National Energy Policy*, released in 2001, which directed the Secretary to "examine the benefits of establishing a national grid, identify transmission bottlenecks, and identify measures to remove transmission bottlenecks." The Department then commissioned *The National Transmission Grid Study*, which was released in May 2002, which warned of the increasing likelihood of significant blackouts. The Grid Study provided several recommendations to improve the operation of the system, including the elimination of transmission bottlenecks and the creation of a new electricity office within DOE. Private sector groups such as the Electric Power Research Institute (EPRI) have also recommended a significant investment in the power system. Its recent study, *The Electricity Framework for the Future*, recommend increased Federal investment in advanced electrical generation, transmission and distribution technologies such as those discussed earlier in this charter.

OETD's fiscal year 2003 R&D budget of $80 million includes research on high temperature superconductivity technologies, transmission systems, distribution and electricity storage technologies conducted through contracts and cost-shared agreements with universities, national laboratories, and industry. The operations and analysis subprogram includes policy modeling, analysis and technical assistance.

5. **Questions for the witnesses:**

The witnesses were asked to address the following questions in their testimony before the Subcommittee:

Questions for Mr. Glotfelty

- Briefly describe the responsibilities and reporting structure of the Office of Transmission and Distribution.
- Briefly describe and rank the key vulnerabilities of the electrical grid as it is built and managed today. Are there technological solutions that could contribute to the reduction of these key vulnerabilities?
- What barriers currently prevent wider adoption of these commercially available technologies? What policy choices would be most conducive to greater adoption of these technologies?
- What was DOE’s decision process in identifying the technologies it is supporting/has supported through the Office of Electricity and Distribution?

Questions for Mr. Glauthier

- What technologies are commercially available or under development to improve the efficiency and reliability of our electrical system? Which technologies would you suggest receive the highest priority for targeted DOE research and development funding?
- What barriers currently prevent wider adoption of these commercially available technologies? What policy choices would be most conducive to greater adoption of these technologies?
- What is the current level of investment by the private sector in improvements to the grid that enhance its reliability? How can the private sector and the federal government best share responsibility for ensuring the reliability of the nation’s electrical grid?
- What level of federal funding would be necessary and appropriate for research, development, demonstration and deployment of smart grid technology? What should the private share be?

Questions for Dr. Smith

- Briefly describe the market structure for the electricity sector as it existed 15 years ago and contrast it with the structure today.
- What barriers currently prevent wider adoption of commercially available energy technologies? What policy choices would be most conducive to greater adoption of these technologies?
- How is uncertainty affecting the economics of investment in the electricity sector? How can we structure a market to ensure reliable electricity at the lowest cost?

- What are the incentives for utilities to invest in transmission research and development? How can we encourage investment in research and development in a highly competitive electricity sector?

Questions for Mr. Casten

- Please give a brief description of your current business ventures designed to capture waste heat.
- How can distributed generation improve the reliability of the overall electrical system? What other benefits does distributed generation provide?
- What barriers currently prevent wider adoption of commercially available energy technologies? What policy choices would be most conducive to greater adoption of these technologies?
- Do some states or regions of the country do a better job at encouraging the dissemination of distributed generation technologies? What specifically makes them different?